

Discriminating Type Ia and Ib PSCs using Satellite Data

A.W. Strawa, K. Drdla, M. Fromm,
K. Bokarius

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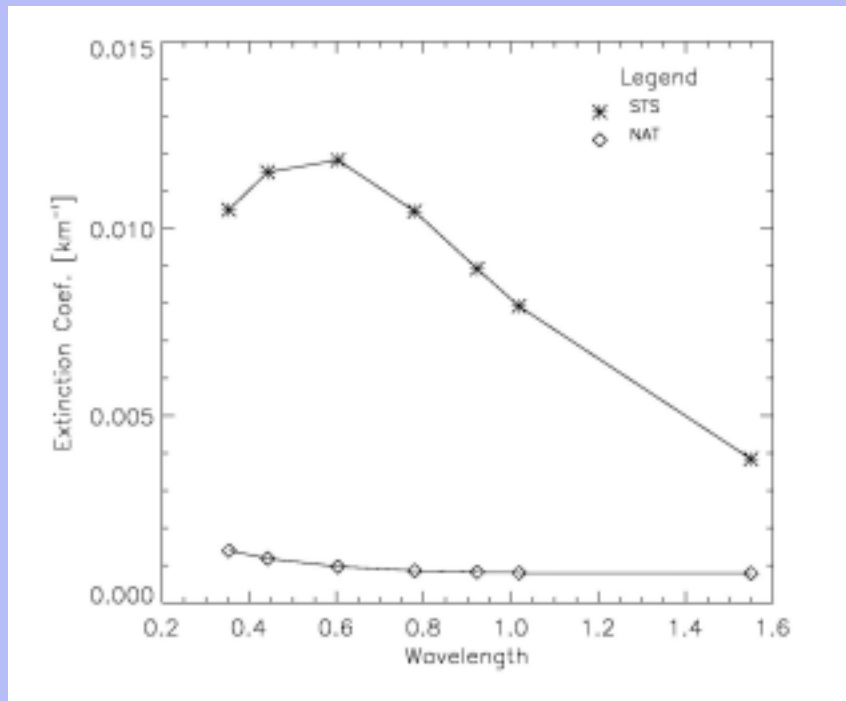


Motivation

- Type Ia PSCs are believed to cause stratospheric denitrification which leads to increased O_3 loss.
- A method that discriminates Type Ia from Ib PSCs using satellite observations is important because it
 - Increases temporal and spatial coverage
 - Enables the study of long-term trends



Comparison of Simulated STS and NAT PSC



STS:
High Extinction
Large Å

NAT:
Low Extinction
Smaller Å

The Ångstrom coefficient is defined as

$$a_1 \cong -\frac{\log(\sigma_{ext}(\lambda_1)/\sigma_{ext}(\lambda_2))}{\log(\lambda_1/\lambda_2)}$$

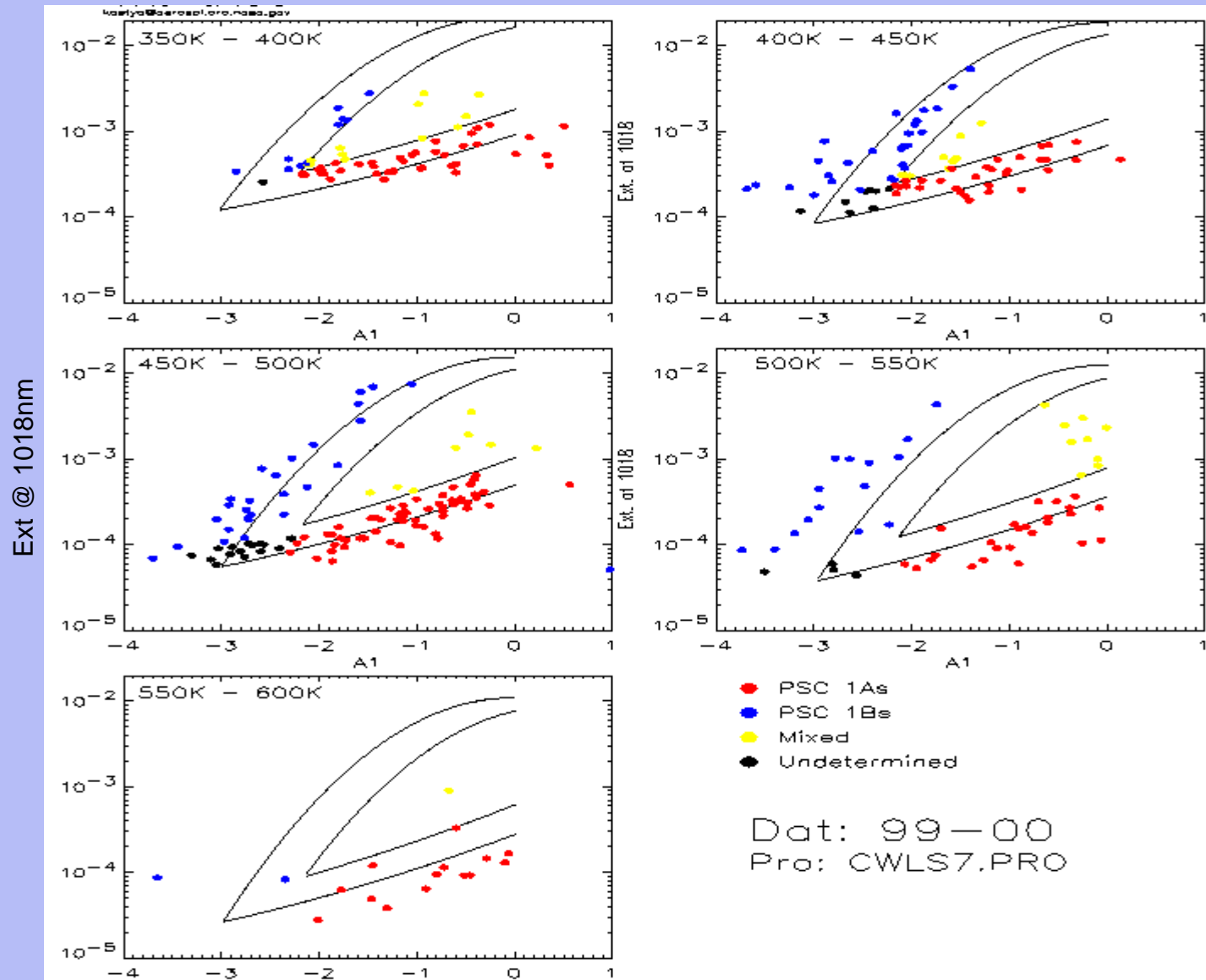


Type I PSC Discrimination Method

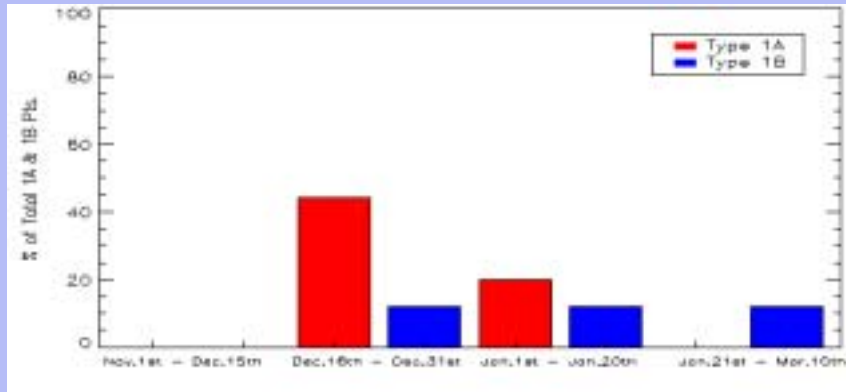
- Observed extinction coefficient at $1\ \mu\text{m}$ are plotted vs Ångstrom coefficient for potential temperature in $\Delta\theta = 50\ \text{K}$ wide bins
- Observations and theory show that Type Ia and Ib PSCs follow different trajectories when plotted in extinction- Ångstrom space
- PSC thresholds are currently based on observations and simulations
- The method used on POAM observations and has been compared to DIAL and OLEX lidar observations made during SOLVE
- Ref. Strawa et al. JGR 107(D20), 8291, 2002.



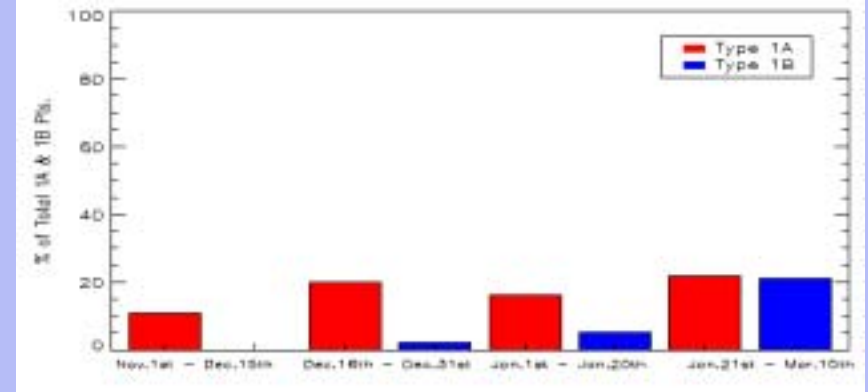
POAM Observations from 1999-2000 Arctic Winter



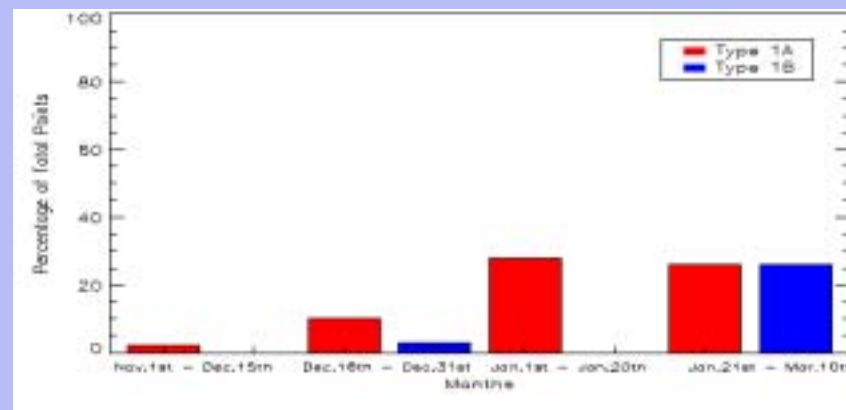
PSC Percentages over Winter - Observations



94-95



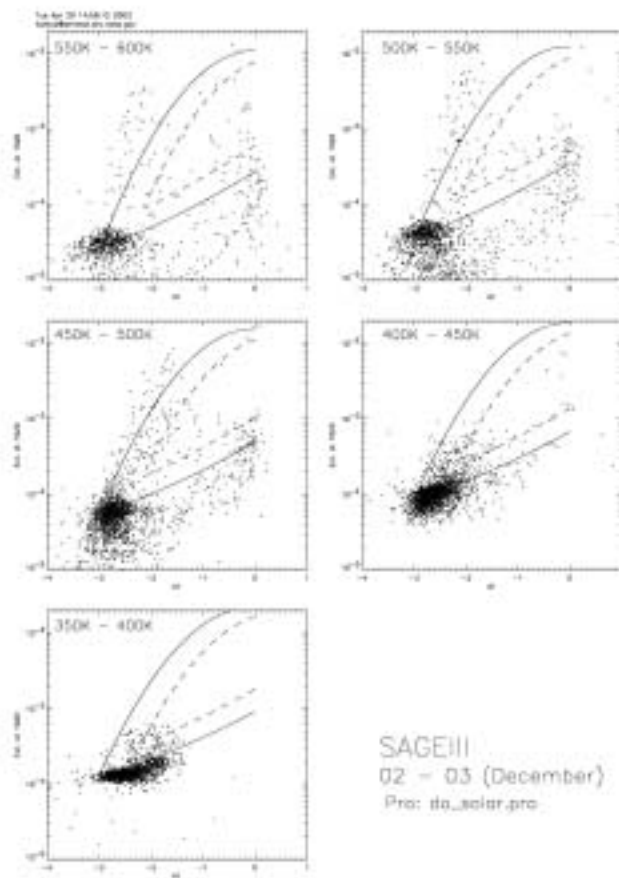
95-96



99-00



SAGE III Dec 2002



- Preliminary application of our discrimination method to SAGE III observations
- Data have not been separated in/out of vortex
- Many features are similar to those observed in the POAM data



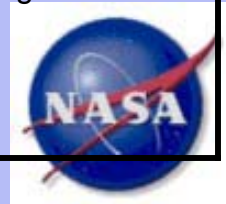
Comparison of POAM Obs with Simulations for SOLVE Winter

- Some recent attempts to compare simulations and experiment
 - Steele et al., 1999 – case studies
 - Santee et al., 2002 – Lagrangian approach
- Our approach
 - Take advantage of Ia/Ib discrimination in POAM data
 - Use IMPACT winter long simulations [Drdla et al., 2002]
 - Compare trends in simulations with observations

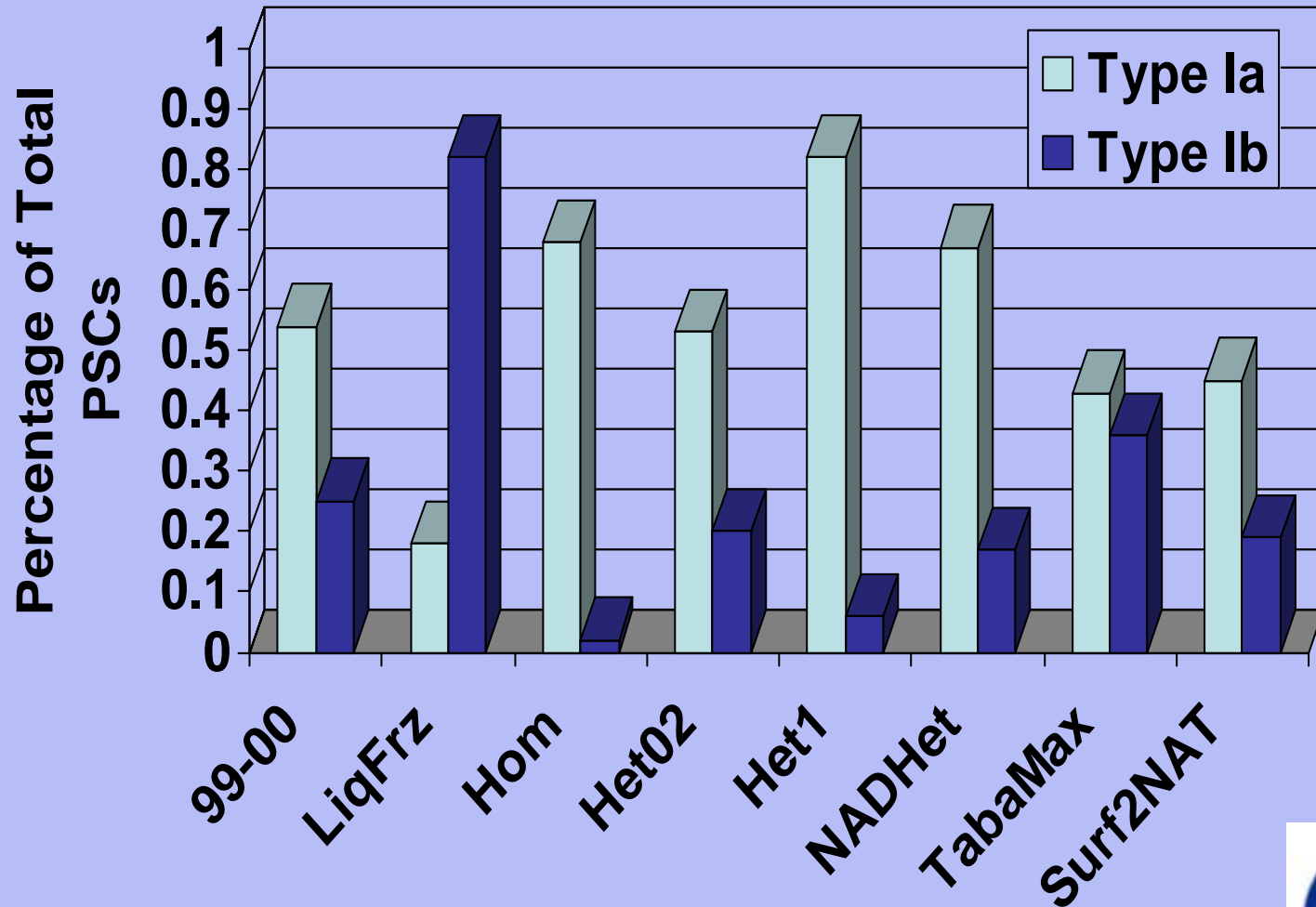


Summary of Scenarios

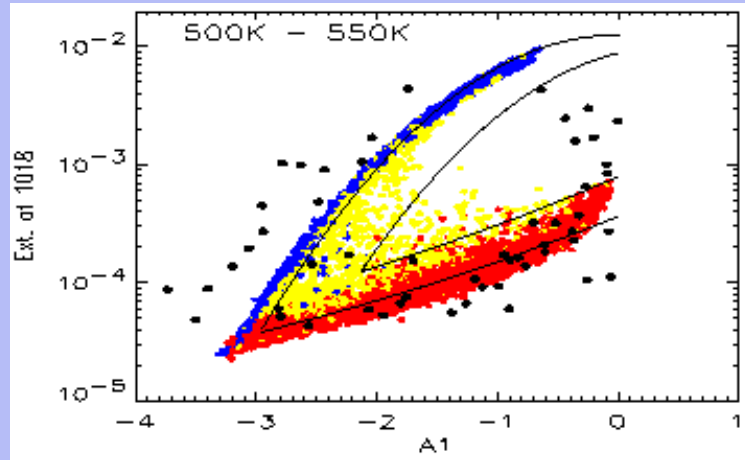
Scenario Name	Homo Freez rate ($\text{cm}^{-3}\text{s}^{-1}$)	Frac of aerosol w/ het nuclei (%)	Nucleation Prob of ice on NAT	Other Characteristics
Liqfrz	0	0	0.75	Water ice freezes, evap. to NAT or SAT. Rates from Tabazadeh et al. [1997]
Hom	10^7	0	0.75	Homogeneous Freezing to NAT
Het02	0	0.02	0.99	Heterogeneous Freezing of NAT
Het1	0	0.1	0.99	Heterogeneous Freezing of NAT
NADhet	0	0.1	0.99	Heterogeneous Freezing of NAD
Tabamax	Homo freezing rates from Tabazadeh et al. [2001]			Homogeneous Freezing to NAT
Surf2NAT	Homo surface-based freezing rates from Tabazadeh et al. [submitted]			Homogeneous Freezing to NAT



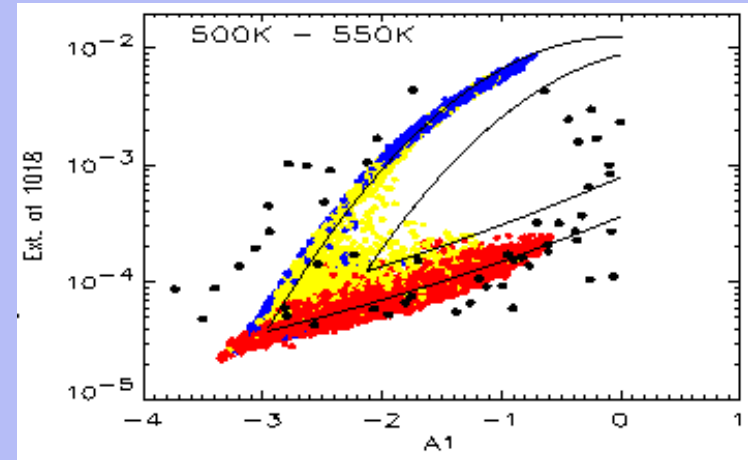
Comparison of Winter-Long Percentages



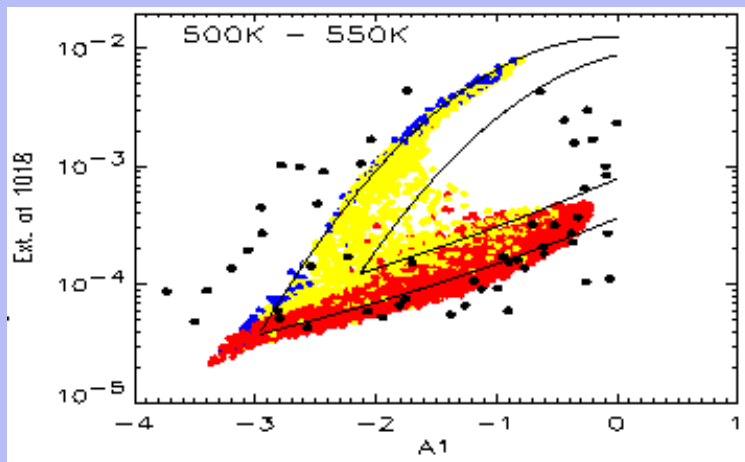
Comparison at 525°K



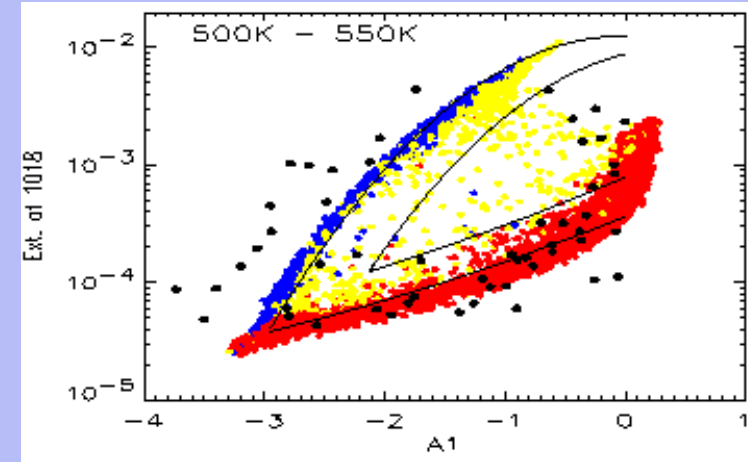
NADhet



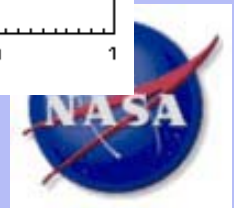
Het02



Tabamax



Surf2NAT



PSC % During 99-00 Winter @ POAM Latitudes

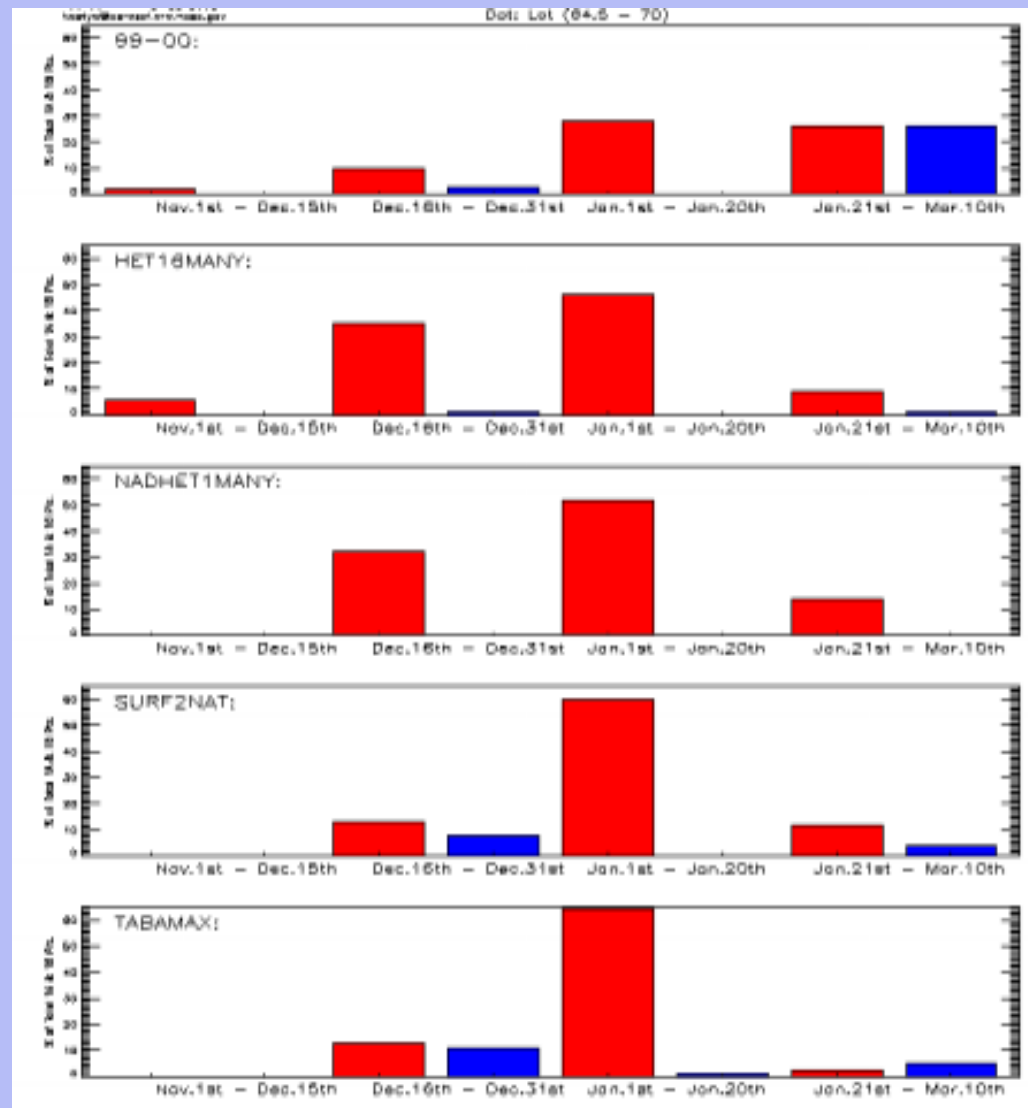
Obs 99-00

Het02

NADHet

Surf2NAT

Tabamax



Ia

Ib



Conclusions

- The discrimination method has been validated with lidar observations from the SOLVE winter
- A statistical comparison of observations and simulations can lead to insights into the validity of certain modeling assumptions
- To date none of the simulations were in complete agreement with the POAM observations
- The method can be applied to SAGE III data.

